DOCUMENT RESUME

ED 311 839 HE 022 940

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TITLE Options for Technology Transfer.

INSTITUTION Forum for College Financing.; National Center for Postsecondary Governance and Finance, College Park, MD.
SPONS AGENCY Office of Educational Research and Improvement (ED), Washington, DC.
PUB DATE Jul 89
NOTE 16p.
AVAILABLE FROM Teachers College, Columbia University, Box 38/525 West 120th Street, New York, NY 10027.
PUB TYPE Collected Works - Serials (022) -- Reports - Research/Technical (143)
JOURNAL CIT Capital Ideas; v4 n1-2 Jul 1989

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Business; Certification; Educational Finance; *Entrepreneurship; Higher Education; Public Policy; School Business Relationship; *Technological Advancement; *Technology Transfer
IDENTIFIERS *Corporations

ABSTRACT

Structural means by which institutions of higher education can tap technology are explored with an examination of the licensing of technological discoveries as well as the creation of start-up companies based upon university-developed technology. Additionally, the corporate structures that are being formed so that institutions can more easily hold equity in these new ventures are considered. A summary of the results of a survey of the emerging structures called corporate affiliates for technology transfer (CATTS) is presented. Sections include: licensing technology (identification and disclosure, protection, the licensing agreement, and royalties in perspective); a brief review of copyrights, patents, trademarks, and trade secrets; reasons for start-ups (more effective transfer of technology, unequal access to licensing, economic development, the rewards of spinoffs, and cautions); and policy issues (public expectations and funding, and threats to institutional culture). The CATTS survey results indicate: there are about 20 to 25 CATTS in current operation (mostly started in the mid- to late-1980s; universities that do not have CATTS are not necessarily eschewing the creation of new technology-based corporations nor making equity investments in those firms, and instead many are forming companies without creating a corporate intermediary; and CATTS serve several purposes including increasing financial and administrative flexibility and protecting the university's tax exempt status. Successful CATTS must be reasonably well capitalized or have some assured funding base. (SM)

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ED311839

CAPITAL IDEAS

a publication of the
FORUM FOR COLLEGE FINANCING

Vol. 4, Nos. 1 & 2
July, 1989

OPTIONS FOR TECHNOLOGY TRANSFER

by

Richard E. Anderson & Barry Sugarman

Colleges and universities, like most organizations, have three kinds of assets — financial, physical, and intellectual. Financial resources include cash, endowment, and debt capacity, all of which should be administered to provide maximum long-term benefit to the institution. An institution's physical resources, as Sean Rush argued in the last issue of **Capital Ideas**, must also be managed with attention to long-term institutional goals. Intellectual resources should be administered with no less diligence and foresight. In fact, these resources should be given even greater attention; for they are, after all, higher education's stock in trade. However, the goal of rational management of intellectual capital is illusive, because of academic traditions and the ephemeral nature of intellectual property.

There are many aspects of intellectual resources. The quality of faculty, staff, and students is certainly the most obvious and important. Another aspect is that set of properties which can be legally owned and which can be protected by copyrights and patents.

For several reasons, college and university administrators are showing increased interest in exploiting legally protected intellectual property, particularly that which is technologically based. In fact, there is almost a gold-rush enthusiasm for converting institutionally developed technology into cash.

This issue of **Capital Ideas** explores some of the structural means by which institutions of higher education can tap technology resources. We will examine the licensing of technological discoveries as well as the creation of start-up companies based upon university-developed technology. Additionally, this issue considers the corporate structures that are being formed so that institutions (and faculty) can more easily hold equity in these new ventures. These emerging structures are termed "corporate affiliates for technology transfer" (CATTS). This spring the Forum surveyed these CATTS and a summary of the results is presented in this issue.

Finally, this issue briefly reviews some policy concerns. Commercializing university intellectual property is more than a financial tactic. It is a strategic shift of considerable importance, and the policy implications of such a change must be considered carefully.

DOUBLE ISSUE

This edition of *Capital Ideas* is a double issue. The next edition will be published in the Fall of 1989

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LICENSING TECHNOLOGY

For several reasons, college and university administrators are showing increased interest in exploiting legally protected intellectual property, particularly that which is technologically based. In fact, there is almost a gold-rush enthusiasm for converting institutionally developed technology into cash.

The education of graduate students and publication of research results in scientific journals notwithstanding, licensing of technological discoveries is the most common formal means by which institutions of higher education transfer technology to the marketplace. The license agreement, however, is the end of a lengthy process which includes the identification, disclosure, and protection of discoveries that have commercial potential. Each of these areas is discussed and these discussions are followed by an analysis which puts the financial returns to licensing in perspective.

IDENTIFICATION AND DISCLOSURE

The first step in the licensing process (or any technology transfer process) is developing a sense of "commercial awareness" among the faculty and research staff. This may sound simple but technology transfer managers assert that one of their fundamental problems is educating faculty members about the needs of the marketplace. These administrators are not suggesting that faculty realign their work to accommodate industrial priorities. However, even the most basic research can produce both techniques and materials with commercial potential. Too often, in the view of these managers, academic scientists develop or discover products and processes for which there are commercial possibilities without considering their potential.

The first step in the licensing process (or any technology transfer process) is developing a sense of "commercial awareness" among the faculty and research staff.

Closely tied to the identification of discoveries is the disclosure of the technology by the faculty to the institution. To ease this communication, the initial process of disclosure should be simple and well understood. The first step may be an informal verbal statement to the technology transfer manager. Eventually, however, most institutions require a formal and specific written disclosure often using a pre-printed form. Even the formal disclosure should be as uncomplicated as possible, perhaps as short as a 2-paged response form. It is from these disclosures that the institution begins to determine which ideas are worth pursuing.

PROTECTION

The next step in the transfer of technology is also the most crucial: the legal protection of intellectual property. In deciding whether to pursue an invention, the technology transfer manager asks himself: Is this discovery worth the considerable expense of not only establishing legal protection, but also vigorously defending that protection? If the answer is no, then the idea may not be pursued. This is the critical question because institutions should expect both legal challenges to as well as infringement of their protected property.

We should note that many institutions are unable to defend their patents simply because the legal process is prohibitively expensive. Additionally, institutions are beginning to ask that their potential corporate licensees pay for the patenting process. (See box on next page)

THE LICENSING AGREEMENT

The licensing agreement is a contract in which the holder of a patent grants to another party the right to use the patented discovery in exchange for some considerations. In a sense, the license is a promise by the licensor not to sue the licensee for infringement. In the Forum's national survey on technology transfer, we identified four primary means through which licenses are executed:

1) Through an internal office of technology transfer;

2) Through an external technology management and licensing firm;

3) Through a multi-university technology licensing consortium;

4) Through an external affiliate of the university or other separate corporation such as a research foundation.

To determine which form of licensing operation is most appropriate for a particular institution, one must examine both

the needs of the institution as well as the talents and resources which an institution is able to provide to the licensing operation. There are several critical success factors in a licensing operation. Among the most important are developing and maintaining a staff which is not only familiar with the various technologies to be licensed but is also familiar with the needs of industry. Additionally, the staff must be capable of generating contacts within corporations that can license the technologies. Finally, the staff must be able to work productively with the faculty.

Developing this type of capable staff can be costly. Many institutions have avoided this cost by using an external licensing organization such as the Research Corporation. But colleges and universities complain that many of these firms do not offer the individual attention that many of their discoveries require. At least one group of universities has addressed both the cost issue as well as the attention issue by organizing a non-profit licensing consortium.

Duke University, the University of North Carolina, and North Carolina State University have formed the Triangle University Licensing Consortium (TULCC). By marketing the discoveries of all three universities, this consortium benefits from economies of scale. It has three professionals with a broad range of scientific and commercial expertise. Because the organization concentrates on these three institutions, it is small enough to provide individual attention. It has been in operation for a year and a half and gets very high marks from each of the participating universities. One important factor in the success of TULCO is the geographic proximity of the three participating institutions. One technology manager familiar with TULCO said, "The ability of the staff from the universities and the Consortium to get into a car and drive a short distance to another campus is extremely important."

Research foundations are used for licensing primarily by publicly supported institutions. These foundations help circumvent restrictive state guidelines governing the acceptance and distribution of licensing royalties. Foundations also tend to have more administrative flexibility than internal offices of technology transfer because foundations are outside the administrative bounds and hierarchy of the institution.

Royalties in Perspective

Although institutions of higher education conclude hundreds of licensing agreements annually with industry, the actual dollar value of these agreements is often exaggerated. A few institutions (Stanford and MIT, for example) are generally cited for the millions of dollars they reap in licensing royalties annually. However, this level of income is exceptional: most colleges and universities measure their total annual royalty revenues in the thousands, rather than the millions, of dollars. Furthermore, many of the institutions with exceptionally large royalty revenues often owe their success to one or a few highly productive discoveries.

The Wisconsin Alumni Research Foundation (WARF) is one of the oldest and best known university licensing organizations in the country. Its vitamin D irradiation patent is one of the most successful university patents. This particular license notwithstanding, WARF's experiences in bringing discoveries from disclosure to license are typical of most other active licensing programs. In an unpublished paper, "Lessons of the WARF Experience," Blumenthal, Epstein, and Maxwell present the following data. Of 1,700 ideas disclosed to WARF between its founding in 1925 and the early 1980s, only 270 (15.9 percent) were patented. Of the 270 disclosures patented, only 62 (23 percent) were licensed. Of the 62 licenses, 43 (70 percent) produced income. However, one third of the 43 licenses brought in less than $10,000 and another third brought in less than $100,000 each. Only nine produced earnings between $100,000 and $1,000,000 and only four brought in over $1,000,000 each. These figures cover a period of nearly 60 years and Wisconsin's total annual operating budget in 1988-89 alone is almost $1 billion.

To add weight to the notion that most institutions should not expect licensing to add significantly to their overall revenue picture, John Preston, Director of MIT's Technology Licensing Office, estimates

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Some colleges and universities save on staff costs by using an external licensing organization. Others complain that many of these organizations do not offer the individual attention that their discoveries require. At least one group of universities has addressed both the cost issue as well as the attention issue by organizing a non-profit licensing consortium.

A Brief Review of Copyrights,

The U.S. government recognizes, and to varying degrees protects, four classes of intellectual property rights: copyrights, patents, trademarks, and trade secrets.

A copyright is an exclusive legal right to reproduce, distribute, perform, prepare derivations of, and display original works of authorship expressed in a tangible medium. These works include literary and musical compositions, sculpture, pictorial and graphic works, motion pictures and audiovisual presentations, and sound recordings. Copyrights exist from the moment of creation of a work, and last until 50 years after the death of the author. Technically, the government does not "grant" a copyright; it only recognizes and registers the existence of a "copy-right." However, registration with the Library of Congress is usually necessary before starting a lawsuit for copyright infringement.

A patent, on the other hand, protects the substantive discoveries of an inventor for a period up to 17 years. A patentable invention must be:

- **Novel**: an original invention which has not been publicly used or sold in the United States, or patented or published in a foreign country, more than one year before filing the patent application;

- **Useful**: the Constitution requires that patents promote the progress of science and the useful arts;

- **Unobvious**: the invention is not trivial, nor is it a trivial improvement on an existing device, nor would a practitioner of a trade using the device consider it an "obvious" development.

For the duration of the patent, the owner has a monopoly right to prevent anyone from making, using, or selling the invention. A patent cannot be renewed, but a new patent with an improvement on the original invention can be filed (and be granted another 17-year monopoly) if the improvement is novel, useful, and unobvious. However, once a patent expires, the invention (without any patented improvements) may be freely produced, used, or sold without the original patent owner's permission and without payment of any royalties.

A trademark is a word or words, symbol, or design that identifies the source of a particular commodity or service. Unlike copyrights and patents, which are protected by the government because of the Constitutional mandate to promote useful knowledge, trademarks are protected under the government's power to regular commerce. Trademarks deserve protection because they are the product of a considerable investment of financial resources, effort, and time in choosing some design and persuading the public to identify it with a particular source of merchandise or service. Trademarks can be registered with the government for a period of ten years, and can be renewed indefinitely for ten year periods. Trademark owners can sue for infringement if someone uses, without consent, a mark that is "likely to cause confusion, or to cause mistake or to deceive."

A trade secret could be a formula, pattern, device, or compilation of information that is kept secret to give the owner a competitive advantage. It can last indefinitely, but only as long as it remains secret. It is lost if it is disclosed or independently discovered by another. The government does not register or formally recognize trade secrets, but the courts may be used to enforce the rights of owners of trade secrets against current or former employees who use or disclose them in unauthorized ways. Trade secrets are of limited value in higher education, both because of the difficulty of maintaining secrets over an extended period of time, as well as the threat to academic values of freedom and openness posed by the monitoring functions and restrictive contracts necessary for preserving these secrets.

Patents, Trademarks, and Trade Secrets

Who owns intellectual property? This is a significant question. A thoughtful analysis of the ownership of intellectual property in the university context was prepared by Lita Nelsen of MIT's Technology Licensing Office and is published in the Proceedings of the Albany Law School Conference on Intellectual Property, (Mathew Bender & Co.:1989), ch. 3. This section draws heavily on Nelsen's work.

Trademarks are usually owned by the university, and any royalties from their use go directly to the institution. Trade secrets are likewise the exclusive property of the university. But copyrights present a more complicated issue. Most colleges and universities make no claim to the ownership of copyrights in books, artistic works, or most other articles produced by the faculty. The ownership of such copyrights is generally vested in the faculty member. Of course, if the university or the university press publishes or subsidizes the publication, it may negotiate with the author for partial or full ownership of the copyright.

When the intellectual property is computer software, a number of ownership problems arise. In the past, software has been copyrighted rather than patented. Nevertheless, these programs are the fruit of a faculty member's research responsibilities, and arise in much the same way as patentable discoveries. They may have commercial value comparable to patents. Therefore, many universities have developed policies for software copyright ownership that are similar to the rules governing patent ownership. Not surprisingly, faculty members protest this policy change. More than one technology transfer manager complains of faculty "stealing away software in the middle of the night." This issue has become so divisive on some campuses that faculty have actually resigned rather than relinquish ownership of software.

Patents comprise the bulk of university-owned intellectual property. As research is funded by a multiplicity of sources, patent ownership varies with the origin of funding. The most significant sponsor of research funds is obviously the federal government. Until just a few years ago, the government legally held title to most discoveries produced under government funding. However, government agencies often waived ownership rights granting them to the institutions conducting the research. With a major change in patent law in 1980 (taking effect in 1981), the government formalized the policy of granting title to universities. PL 96-517 gave the title of inventions arising from U.S. government sponsored research directly to the colleges and universities. Under this law, institutions are encouraged to license these discoveries and are subject to few restrictions, three of which are as follows:

- An irrevocable, nonroyalty-bearing, nonexclusive license is reserved by the U.S. government for government purposes.
- Licensees must make a good faith effort to manufacture products for the U.S. market substantially in the U.S.
- The government may exercise "march-in" rights if a licensee is not exploiting the technology.

Although private sponsorship of academic research does not compare in size with government support, it is growing. Patents from this research are subject to much greater variation in ownership rights than government-sponsored research. When concluding contracts for industrially sponsored research projects, most institutions will attempt to retain title to patented discoveries. However, some sponsors will not agree to this stipulation and will demand assignment of the patent rights. Even if the university retains title, it is common to "pay the piper" with an exclusive license to use and develop the discovery.

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that MIT, Stanford, The University of California System, and the University of Wisconsin system together will account for over half of all U.S. university-industry licensing agreements this year. Yet, these universities account for only 13 percent of total research dollars spent by institutions of higher education in the United States. Thus, exclusive of the major successes and in view of WARF's experiences, the revenue most institutions can expect to receive from licensing will be dwarfed by other revenue sources such as government funding and gifts.

Why Start-ups?

Only in the last few years has higher education become more entrepreneurial and begun actively creating new companies based upon faculty-developed technology. In fact, until the mid 1980s, many colleges and universities were adamant in prohibiting such ventures. For some institutions, the shift has been swift and dramatic.

Four factors seem to be fueling this more aggressive approach to technology transfer.

1) It is increasingly apparent that certain technologies are more easily transferred to the marketplace through new ventures instead of through licensing programs.

2) The licensing process is not equally accessible to all institutions.

3) State legislatures actively promote the formation of new companies to foster statewide economic development.

4) The financial payoff from creating new companies and earning equity can be considerably greater than earning royalties through licensing.

We address each of these factors below.

More Effective Transfer of Technology

Technology transfer is by no means an exact discipline. Its managers do not benefit from rule books to guide their practice. Yet, recently, institutions have become aware that they can bring certain discoveries to the marketplace more effectively with certain modes of technology transfer. Before we consider those technologies which are more applicable to spinoff company formation, we discuss situations where licensing is preferred.

Some discoveries spawn an entire range of new technologies which may extend into completely different markets than the original discovery. A start-up company which is not focused on a pre-established market may be more capable of pursuing the broad range of new technologies than an existing company which is entrenched in a particular market.

Licensing Preference: Technology transfer managers observe that one of the most effective methods for transferring a particular technology to the marketplace is to find an existing company within which this technology fits well. More significantly, though, the university must convince that company to be committed to developing this technology and to devoting its resources to the task of ensuring that this discovery is brought to market.

In developing some discoveries, speed is essential. For example, if it is known that another firm is developing a competing technology, there may not be sufficient time to organize a new company. In this case, licensing to an existing company may be the only means which affords a reasonable likelihood of success. Other technologies command such a small market that, alone, they cannot adequately support a new company.

Spinoff Preference: Much of the technology which emanates from college laboratories is still in an early stage of development. Even if the discovery is patentable, it still may require substantial infusions of time and money before it is ready for market introduction. Large, established corporations are often unable to provide the level of attention that a start-up can provide to the developing technology.

Additionally, some discoveries spawn an entire range of new technologies, some of which may extend into completely different markets than the original discovery. A start-up company which is not focused on a pre-established market may be more capable of pursuing the broad range of new technologies than an existing com-

pany which is entrenched in a particular market. One university official comments that Boeing Aircraft is not as likely to pursue the photographic applications of a technology licensed for jet instrument development as would be a spinoff without ties to the aircraft market. Finally, most technologies will not add significantly to the bottom line of large corporations. Yet, even a small technology can have a significant impact on a start-up.

Unequal Access to Licensing

We noted in the previous section that a few universities dominate in licensing to industry. One reason for their dominance is that access to existing companies, particularly large corporations, is not uniform. A college without close ties to industry may have difficulty simply finding the correct person with whom to speak about licensing a particular technology. Further, a cautious corporate executive can protect himself by licensing only from one of the "name" institutions. Thus, only a handful of universities have both the corporate contacts and name recognition to be major players in the licensing game.

Economic Development

To the consternation of advocates of a national industrial policy, the federal government has been slow to embrace an economic development agenda. States, on the other hand, are actively setting up policies and programs to bolster their respective economies. For example, most states have set a high priority on improving their schools. Some states have created programs to stimulate exports. Others are trying to fill gaps in the capital markets.

Many states, persuaded by Professor David Birch's analysis that small businesses generate a disproportionately large share of new jobs, are trying to stimulate the establishment of new companies. When this concept of fostering the creation of new companies is married to the states' desire for technologically based industry, the state universities become obvious players in the process. Consequently, governors and legislators not only accept university activity in creating small businesses, but most actively encourage it.

It should be pointed out that a revisionist view asserts that there are dysfunctions to this "chronic entrepreneurialism," as Robert Reich phrases it. These small companies may be unable to compete with larger, better organized foreign competitors. There are also questions about the stability of the newly created jobs. Universities cannot be certain, therefore, that public policy will not change regarding the desirability of creating new technology-based companies. Additionally, economic development can be hampered if these small companies fail, thereby tying up the license to the technology.

The Rewards of Spinoffs

There is generally a positive relationship between risk and reward in business, and this association almost certainly holds for a university investing in its own technology. The license agreement offers low risk and a contractually guaranteed fee structure. However, by avoiding risk, the institution forgoes the chance for considerably greater financial gain. The spinoff, on the other hand, is substantially more risky (as is any new venture) but offers the potential for meteoric growth.

The now famous 1980 case involving Harvard University and Harvard professor Mark Ptashne illustrates many of the factors involved in the license-spinoff decision-making process. In April 1979, General Electric's venture capital subsidiary offered Harvard $500,000 for the patent rights to a biotechnology discovery made by Ptashne. Harvard, instead, chose to pursue the concept of developing a start-up company in which both the University and Ptashne would hold equity stakes. Although Harvard eventually backed-out of the deal, Ptashne pursued the development of the company. That company, Genetics Institute, was valued at over $300,000,000 by 1988. Had Harvard's plan to invest in the new company proceeded, their proposed 10 percent stake in the company would have returned $30,000,000 over eight years from an initial investment of $500,000 worth of technology (an annual return of over 66 percent).

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The potential cost of future product liability claims should not be minimized. Properly established and utilized, separate corporate structures for technology transfer can be an important means of reducing this liability.

Cautions

To provide a more realistic assessment of spinoffs, we present a few cautions. First, as seductive as the potential rewards of spinoffs are, institutions must recognize that the license-spinoff decision is never made with 20-20 hindsight. In being compensated for risk-taking, the investor cannot know whether his investment will succeed or fail. Although licensing usually generates relatively immediate revenue, most start-ups require a number of years before they provide the stockholder with significant capital gains. In fact, the investors should be prepared to suffer several years of losses. Finally, the potential cost of future product liability claims should not be minimized. Properly established and utilized, separate corporate structures for technology transfer can be an important means of reducing this liability. The issue of product liability is considered further in the special section on corporate affiliates.

Policy Issues

A major purpose of the Forum for College Financing and of **Capital Ideas** has been to consider alternative revenue sources for higher education with an emphasis on the practical aspects of those alternatives. In the case of technology transfer, however, the policy issues loom so large that they must be confronted.

The institutional goal of maximizing financial returns from intellectual property seems reasonable. But colleges are complex organizations which are not easily compartmentalized. Realigning part of an institution towards generating profit is likely to have a profound impact on the rest of the organization. Where there are changes to the customs and culture of universities, we should proceed with great caution.

The institutional goal of maximizing financial returns from intellectual property seems reasonable. But colleges are complex organizations which are not easily compartmentalized. Realigning part of an institution towards generating profit is likely to have a profound impact on the rest of the organization.

Nicholas Wade wrote a persuasive and troubling background paper for the Twentieth Century Fund Report, The Science Business. In that treatise he reviews a number of significant concerns about the commercialization of academic science. These include:

1) Faculty, distracted by industrial research, may neglect their educational responsibilities. This neglect may manifest itself in inadequate class preparation. Or it may be more subtle as graduate students are sidetracked into developmental work for industry.

2) Science as a whole may be diminished if the faculty tends to pursue applied, rather than basic, research.

3) Science may also suffer from the growing secretiveness between and within laboratories.

4) The increasing dependence of academic researchers on industrial support can reduce the willingness of researchers to speak out on important issues in science. This same financial dependence can undermine their credibility if they do speak. Wade points out that virtually every top micro-biologist has an industrial affiliation.

5) Research funded by the federal government will be unfairly funneled into the corporations affiliated with university research. Other corporations with presumably equal claim to the research will be shut out.

These concerns are real and substantial. Wade and others make very compelling cases about the need to protect the public interest. There are at least two other potential problems that may accompany the commercialization of academic technology. We would classify both of these as institutional strategic concerns.

The general ethos of academic science is that ideas cannot and should not be owned. They are public property. In fact, this free broadcast of knowledge is the most prevalent means of disseminating university-based research — scientific and non-scientific. Colleges and universities receive public and charitable support based, at least in part, on their role in creating and freely disseminating knowledge. Moreover, the cultures of the institutions, as well as their personnel practices, have been developed around these precepts. Reorienting universities into merchants of knowledge without fully taking into account the expectations of external

funding agents and without careful consideration of the effects of this change on institutional cultures would be shortsighted. These two issues are considered briefly below.

Public Expectations and Funding

The prospect of technology transfer calls to mind major advances in gene splicing techniques or the creation of new electronic processes. One quickly sees obvious and immediate commercial applications. But scientific research is typically much more incremental — new discoveries, representing tiny steps, are built on the advancements of others. Free dissemination of knowledge fosters scientific progress and, presumably, the betterment of mankind. The pursuit of these "noble" purposes is a major reason that colleges and universities are supported with public funds, tax exemptions, and charitable contributions. If colleges and universities are perceived to be too self-serving, the long-term stability of this funding could erode. There are already signs of strain.

The Tax Reform Act of 1986, for example, greatly restricted access to and the flexibility of tax-exempt financing. Although a primary reason for the most onerous changes was a federal appetite for increased revenue, at least part of the impetus was the perception that nonprofit organizations were abusing their capital financing privileges. More fundamentally, there is a growing public concern that higher education has rapaciously raised tuition charges while not effectively monitoring and regulating program quality. Most directly related to the commercialization of academic science is the long-term and growing concern by the business community that colleges and universities are taking unfair advantage of their tax-exempt status and public funding when they compete with the for-profit sector.

For each of these assertions of university greed and malfeasance, the evidence is slight. Nonetheless, the fundamental point stands. Higher education should not jeopardize its primary sources of support by attempts to maximize income from subsidiary sources — including technology transfer. Certainly colleges and universities have a right and a responsibility to increase the income from the technology produced in their laboratories. But the net revenues from technology transfer at the most successful institutions does not exceed one percent of their current income. Clearly, these new strategies for technology transfer must be thoroughly crafted to protect against the potential for a political backlash.

Complicating higher education's response to this strategic issue is the fact that state lawmakers are among the prime movers in technology transfer, specifically the creation of new businesses within their state. This political interest notwithstanding, higher education should move cautiously as next year's lawmakers may have little sympathy for the agenda of their predecessors.

Threats to Institutional Culture

In addition to the concerns about external financial support, the internal reward system and personnel practices of higher education support the concept of free dissemination of technology. The faculty, particularly those at research universities, are promoted to a great extent on their publications and their standing among their peers. Those who are successful are rewarded with life-time contracts. Even the pension funding of most professors, which is fully and immediately vested, supports the independence of the faculty. The result of these policies is to foster and encourage the pursuit and dissemination of knowledge. As a side-effect, tenured faculty are almost as free to pursue commercial or personal interests. Abuses of faculty freedoms are limited by the manner in which professors are selected and promoted and by a culture that honors academic achievements above all others. New practices which bend the culture toward a more commercial orientation or which similarly alter administrative decision making, may have significant and unintended consequences.

Raising these cultural/personnel concerns does not argue against implementing more enterprising technology transfer practices. But these changes must be considered within the current higher education environment.

Specifically, there are three additional

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policy concerns which suggest that a broader review of personnel practices may be needed. First, mandatory retirement has been essentially eliminated by federal statute, raising concerns about the impact of tenure policies on the age distribution of faculty. Second, the disparity in market demand across academic disciplines is growing wider (e.g., colleges are having more difficulty paying industry standard wages to scientists, while historians may be overpaid by "external market standards"). Third, few colleges have fully thought through the disparate treatment of patent and copyright royalties. Now, we are adding to this policy stew the increasing possibility that some faculty may become wealthy as a result of their academic research. Taken together, these issues point to an obvious need for a more thorough and strategic review of personnel policies.

Summary

The reluctance of the most prestigious institutions to invest in their own technologies has all but disappeared in the last few years. Yet, shifting to a more aggressive policy on technology transfer should not be viewed simply as a tactical maneuver. For most institutions, it represents a fundamental strategic change and should be approached in that way.

There are considerable benefits to institutions that pursue a more financially aggressive policy towards technology transfer. But there are also obstacles and real risks. For spinoffs, the rewards are uneven and uncertain. Corporate affiliates can be a useful organizational structure to solve some problems and to reduce some risks. However, whether or not a university forms a new corporation, it must be prepared to invest resources into the technology transfer endeavor if it expects to reap a positive return. Joint ventures with other institutions may be a useful compromise in this effort.

The reluctance of the most prestigious institutions to invest in their own technologies has all but disappeared in the last few years. This change at the leading universities notwithstanding, each institution will have its own cost-benefit equation to consider.

Shifting to a more aggressive policy on technology transfer should not be viewed simply as a tactical maneuver. For most institutions, it represents a fundamental strategic change and should be approached in that way. General personnel practices should be carefully reviewed when considering such a change. In the end, institutions of higher education must recognize the potential long-term effects on other sources of revenue as well as the effects on institutional culture.

Special Section: Results of a Survey on Corporate Affiliates for Technology Transfer (CATTS)

Higher education is not immune from the national enthusiasm for harnessing the economic potential of technology. Furthermore, university officials are becoming considerably more possessive toward the products of their laboratories. Not only are these officials interested in a financial return from the technologies developed in their laboratories but they want a higher return than licensing agreements generally provide. This change in attitude has led to a mini-industry of creating spin-off companies based on university technology. In addition, state legislators, inspired by the legendary job-creating potential of small companies, have been cheerleaders of the process.

The systematic spawning of new companies, however, brings a host of organizational, financial, and legal problems. The most obvious is that public institutions are often statutorily prohibited from creating and owning companies. All institutions, public and private, must worry about the long reach of potential future product liability claims that could be generated by these new companies. In addition, the systematic incubation of new companies requires management talent, legal expertise, and financing that may be cumbersome to acquire within the existing framework of colleges.

In response to these problems, universities have established corporate affiliates to facilitate the transfer of their technologies into start-up companies. These

CATTS act as corporate intermediaries between the university and the new technology-based firms. CATTS take a variety of forms. Some are for-profit while others are non-profit. Some are wholly-owned, while others are created in partnership with other organizations and individuals.

About a year ago, the Forum began talking with officers of these new intermediary organizations. To establish a more systematic base of knowledge, we sent questionnaires to the largest 100 universities asking if they had such intermediaries. From those universities which responded affirmatively, we collected data on corporate form, size, and on financial and other characteristics. This section summarizes those findings. It is neither a detailed legal nor financial analysis, but offers a quick sketch of these corporate affiliates.

How Many CATTS?

Fifteen of our respondents described ongoing CATTS. There are, however, a number of institutions which we know have these technology transfer affiliates but which chose not to respond to the survey. In addition, there are undoubtedly a few that we do not know about. A reasonable estimate is that there are at least 20 to 25 CATTS in current operation. Most of these were started in the mid- to late-1980s. (See chart 1)

Chart 1: CATT Starting Dates

Prior to 1950	2*
1950-1983	1
1984	2
1985	1
1986	4
1987	2
1988	3
1989	1
Total	15

* One was a foundation that only recently began creating spinoff corporations

We asked the respondents that did not have CATTS about their plans for such organizations. At least nine are actively reviewing the option. In view of how rapidly these organizations have appeared on the university scene and the interest that has been expressed, we estimate that within a year or two there will be about 30 of these affiliates.

Universities that do not have CATTS are not necessarily eschewing the creation of new technology-based corporations nor making equity investments in those firms. A number universities, particularly private ones, are forming companies without creating a corporate intermediary. The director of licensing and technology at a leading private research university explained: "Currently we think that the advantages of having technology transfer [within the institution's current corporate structure] outweigh the legal benefits (product liability, etc.) of creating a separate corporate shield."

What Corporate Form?

Of the 15 CATTS described in our survey, nine were nonprofit. Six were set up as for-profit corporations. When we factor in the known structure of other CATTS that did not respond, however, for-profit and nonprofit affiliates are nearly equal in number. (See chart 2)

Chart 2: Types of CATTS

	Public	Private	Total
For-Profit	4*	2	6
Not For-Profit	6**	3	9
Total	10	5	15

* 3 are owned by university foundation

** 3 CATTS are university foundations whose missions were expanded to spin-off new companies

Nonprofit: Of the nine nonprofit CATTS, six were at publicly supported universities. Of the six public non-profit CATTS, three were foundations whose missions had been expanded to include the formation of new corporations. Each of these more "aggressive" foundations owned equity in start-up companies. All were rather substantial when compared with most other affiliates. The annual incomes of these foundations ranged from $300,000 to $700,000, although a large share of that income (over 50% for the largest CATT) was derived from royalties.

A reasonable estimate is that there are at least 20 to 25 CATTS in current operation and that, within a year or two, there will be about 30 of these affiliates.

If a public institution wants to create a for-profit CATT, a logical structure is to use the university's foundation as a holding company.

The three non-foundation public CATTS were new, small, and undercapitalized. Although it is too early to predict whether they will succeed, two respondents suggest that they are struggling (the third was just founded in 1989).

Each non-profit CATT at the private universities had special characteristics. The largest was jointly established by the university and an affiliated national laboratory with substantial base funding from both organizations. With strong base financing and access to the research of both organizations, the affiliate is both stable and generating surpluses. The two other non-profit CATTS at private universities represent two extremes to launching such enterprises. One was capitalized with $250,000 from the university four years ago and continues to receive operating subsidies. But it has generated nine new companies and is expected to break-even within five years. The other private university in this group was considerably more conservative. Its affiliate was not capitalized at all nor was it staffed. Its purpose was neither to create financial flexibility nor protection against legal claims. According to the university's treasurer, it was formed primarily "to give visibility to the institution's interest in creating new companies." Perhaps because of this limited commitment, it has not been very successful and has helped launch only one new company since its founding two years ago.

For-Profit: If a public institution wants to create a for-profit CATT, a logical structure is to use the university's foundation as a holding company. Three of the four respondents followed this mold by creating for-profit subsidiaries wholly owned by the university foundation. The fourth for-profit affiliate of a public institution has a rather special background. In 1987, the Texas Legislature passed the "Equity Ownership Bill," which specifically permitted Texas public universities to hold an equity interest in university created corporations. In the wake of this legislation, Texas A&M University formed a for-profit CATT to help the university and its faculty create new spin-off corporations. As Meg Wilson and Stephen Szygenda reported in a presentation given at the Conference on the University Spinoff Corporation in 1988, the Texas law also allows university employees who develop intellectual property to hold equity shares in the resultant corporations and to direct and manage those firms. Thus, the Texas legislature has purposefully enabled the universities and their faculty to pursue technology transfer through start-up companies.

Three of these four public for-profit CATTS were too new to provide any evidence of their ultimate success. The fourth has been in existence for five years and is still a rather small operation, having helped create only three companies. The president of this affiliate complains, as did many of his colleagues at non-profit CATTS, of being undercapitalized.

The two for-profit corporate affiliates created by private universities were both relatively substantial. One had income in 1988 of over $500,000 and the other's income exceeded $1.25 million. The larger of the two is a wholly owned subsidiary of the university. The other is a limited partnership (LP).

Although LPs used to have significant tax advantages, these essentially have been eliminated by the Tax Reform Act of 1986. This organizational structure in now used solely for convenience. In a limited partnership the general partner makes decisions and may or may not invest. Furthermore, the expertise and contacts of the general partner is considered to be a critical success factor in LPs. Limited partners bring capital or, in some cases, technology to the ventures. If universities are limited partners in a venture, they will not be the primary decision makers. This status affords a certain academic and legal insulation. In the development of a technology with an LP, a corporate "exit vehicle" is generally established with ownership and rights of the general and limited partners set beforehand.

The general partner in the LP in our survey was a venture capitalist in a complicated partnership with a large corporation. The university was the limited partner.

Purpose of CATTS

These organizations serve a number of purposes. We asked the officials who responded why they chose their specific

form of corporate structure. A listing of the choices with the average ratings are given in chart 3 below. (Ratings are on a scale of 1 to 5 where 1 = most important.)

Increasing financial and administrative flexibility are given as the two most important reasons for creating these affiliated corporations. Protecting the university's tax-exempt status is listed as the third most important benefit. Michael Goldstein, a law partner at Dow, Lohnes & Albertson, however, disputes that this tax insulation should be a major consideration as a number of other options are available including the university's potential payment of unrelated business income taxes.

Goldstein does argue that protection from future product liability claims should be given considerably more attention. It is clearly possible to create a "Chinese wall", but probably at some loss of control over the technology transfer process. The cost of this loss of control may be a small price to protect an institution's billions of dollars of endowment and other assets. Ed MacCordy, Associate Vice Chancellor for Research at Washington University in St. Louis echoes this concern. He asserts, "The whole business [of technology transfer] is waiting for lightning to strike." As universities do developmental work for industry, it is not at all clear that the courts will insulate them from product liability claims under many of the existing corporate structures. MacCordy supports the WARF model, in which ownership of patents is automatically transferred from the inventor to the Foundation. The University never takes title to inventions and, thus, never licenses to WARF. This is a key means of protecting the university from product liability suits. Unfortunately, the assets of WARF are so enormous that it is a tempting target for litigation in its own right.

Some of the larger CATTS list increasing financial remuneration as their highest priority. Others, who did not list it, revealed this as a primary motive in subsequent conversations.

Financial Success of CATTS

We asked officials to estimate total net revenue and accrued equity to their institutions over the life of the affiliate. Most could not, or did not, respond. But judging from the founding dates and the number of start-ups formed, their total net financial gain was probably quite small. Those CATTS with a longer history were more likely to respond to this item and the answers ranged from $200,000 to $5,000,000 for total income and accrued equity. These amounts are not trivial, but neither are they large enough to have a major impact on institutional funding.

The payoff of technology transfer, however, is long-term and many of these organizations are quite new. Another way to measure potential success in the coming decades is by the number of new ventures formed by the affiliates. Responses to an inquiry about this ranged from 0 to 50. However, when we take into account the year in which the affiliates were formed, the rate of new venture formation is strikingly even. Most CATTS consistently generated 2 to 3 new companies each year. At this rate, if the new ventures remain viable, institutions can look forward to some financial gain in the future.

"The whole business [of technology transfer] is waiting for lightning to strike." As universities do developmental work for industry, it is not at all clear that the courts will insulate them from product liability claims under many of the existing corporate structures.

Chart 3: Reasons for Choosing Forms of Corporate Structure

Answer	Mean
Increase financial flexibility	1.7
Increase administrative flexibility	1.7
Protect tax-exempt status of university	2.1
Pay market compensation to management	2.8
Protect university from product liability	2.9
Provide more external expertise	2.9
Increase financial remuneration to university	3.3
Protect university from adverse publicity	3.4
Insulate developmental research from campus activities	3.4
Lower overhead rate	4.0

A model for CATTS which deserves more consideration is a consortium approach similar to the Triangle University Licensing Consortium, but with specific emphasis on new venture formation.

Other Characteristics: The membership of the governing boards of the affiliates surveyed is diverse. By far, however, the most common type of governing board member is either a business executive drafted to sit on the board or a university administrator.

The affiliates were asked to rank the primary sources of capital for the new ventures. The most significant sources of funding were, in order of importance, venture capital funds, corporations, non-university private investors, faculty/inventors, university endowments, and university operating funds.

Summary

The lessons that can be drawn from this small survey are obviously limited. One theme that does recur, however, is that successful CATTS must be reasonably well capitalized or have some assured funding base. Public institutions can use their research foundations for this purpose. An alternative of for-profit CATTS is to use private capital. Of course, this type of partnership will dilute the university's potential gain. An advantage is that the private capital is accompanied by business and technical expertise. One official noted that his institution relied heavily on their venture capital partners to flag the best prospects. According to this respondent, "If they're willing to back it, we're much more comfortable investing some of our endowment."

A third model for CATTS which deserves more consideration is a consortium approach similar to the Triangle University Licensing Consortium, but with specific emphasis on new venture formation. A consortium can combine the best of the expertise of a commercial organization with the attention of an in-house staff.

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